

EVALUATION OF TURMERIC GERMPLASMS FOR TOLERANCE TO FOLIAR DISEASES IN TERAJ REGION OF WEST BENGAL

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ABSTRACT

Leaf spot and leaf blotch of turmeric is an important phytopathological constraint in cultivation in the turmeric growing areas of India. Among the different genotypes CL 32, CL 34, CL 52, CL 54 (from Coimbatore), RH 406, RH 407, RH 410 (from Dholi), TCP 14, TCP 129, TCP 161 (from Pundibari) and TCP 2 (Local check) it was found that TCP 129 recorded lowest leaf blotch (PDI 12.78) and leaf spot (PDI 7.26) disease severity. The highest leaf blotch disease severity (PDI 31.48) was recorded by RH 406 closely followed by RH 407 (PDI 31.16) whereas the highest leaf spot disease severity (PDI 36.38) was recorded by RH 410. TCP 129 produced 46.48% and 70.03% less leaf blotch and leaf spot disease over local check respectively. Over all 4 germplasms were found to produce lower leaf blotch disease severity and 6 germplasms produced lower leaf spot disease severity than local check variety (TCP 2). The highest yield of 14.34Kg/plot (projected yield 28.91t/ha) was obtained by TCP 129 which was also found to have lowest leaf blotch and leaf spot severity. The lowest yield of 7.83 Kg/plot (projected yield 15.79 t/ha) was recorded by RH 410. TCP 129 is therefore highly recommended for the farmers which will produce very high yield in the terai region of West Bengal.

KEYWORDS: Leaf Blotch, Leaf Spot, PDI, Yield, Projected Yield, TCP 129

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INTRODUCTION

Turmeric, the sacred spice of Asian countries is the rhizome of *Curcuma longa* L., is a herbaceous perennial nature, native to Indo Malyan region. India is the largest producer and exporter of turmeric contributing about 80% of production and 45% of export (E.V. Nybe *et al.*, 2007). In India Turmeric is cultivated in Andhra Pradesh, Orissa, Tamil Nadu, Kerala and West Bengal. In pharmaceuticals it is valued for the anticancerous, anti-inflammatory and anticeptic properties for producing monoterpenes and sesquiterpenes in dry and fresh rhizomes (R Priyanka *et al.*, 2015). Turmeric is affected by many diseases like soft rot, leaf blotch and leaf spot etc. Among that leaf blotch is caused by *Taphrina maculans* (Sharma *et al.*, 1994) and leaf spot caused by *Colletotrichum capsici* both of them are serious problem. Turmeric crop (*Curcuma longa* L.) is affected by two major diseases caused by *Colletotrichum* leaf spot (Reddy *et al.*, 1963) *Taphrina* leaf blotch (Rao 1995). Leaf blotch of Turmeric was first reported from Rangpur (East Pakistan) (Butler, 1911). Singh *et al.* (2000) recorded that leaf

blotch disease was reduced by spraying with 0.3% Copper oxychloride, 500 ppm Metalaxyl, 0.1% Thiophanate methyl, 0.1 % Carbendazim, 0.3% Mancozeb and 0.3% Propineb in the field experiment of Madhya Pradesh. Panja *et al.* (2001) tested 15 turmeric cultivar against leaf blotch during 1996-1999 at Terai region of West Bengal. Results indicated that Nagaland local, Tall clone Assam, PCT 14, Sonajuli local, Sugandham and Meghalaya local were highly susceptible, Rh 5, Rajendra sonia and PCP-13 were moderately susceptible and PTS 62, ACC360, ACC361, Roma, BSR 1 and Kasturi were resistant to leaf blotch disease. The leaf spot disease was first recorded in Coimbatore district of erstwhile Madras state (McRae, 1971). Ramakrishnan, 1947 suggested that *Colletotrichum curcumae* with *Colletotrichum capsici* causes leaf spot in turmeric. It is now considered that *Colletotrichum capsici* is the causal agent. In Chhattisgarh turmeric genotype TCP 11 showed resistance to leaf spot and leaf blotch and turmeric genotype TCP 82 showed moderately resistance to *Colletotrichum* leaf spot and resistant to *Taphrina* leaf blotch (Singh, 2013). The check variety IISR Prativa showed moderate resistance to both leaf spot and leaf blotch of turmeric (Singh, 2013). Narasimhudu and Balasubramanian, (2002) tested different fungicides against *Colletotrichum* leaf spot. Among the fungicides evaluated Topsin-M (0.1 %) was found to be effective followed by Indofil M-45 (0.25%) and Bavistin (0.1 %) when *Colletotrichum* leaf spot incidence and yield were taken into consideration. Singh *et al.* (2003) found that the most effective fungicide i.e. score 25 EC (0.1 %), tilt 25 EC (0.1 %) and dithane M-45 75 WP (0.25%) were evaluated as spray schedule against leaf blotch of turmeric. All the fungicides significantly reduced the disease severity. Minimum disease severity of 24.4% was recorded with score followed by tilt with corresponding disease reduction of 67.6 and 55.2, respectively. In Low hill condition of Himachal Pradesh Clone DKHT-6 showed resistant reaction to leaf blotch of turmeric (*Taphrina maculans*) (Singh *et al.*, 2000). Turmeric cultivar PTS 12, PTS 62 and ACC 360 ACC 361 were found to be resistant to leaf blotch and leaf spot disease (Khalko and Chowdhury, 2011). Similar type of result was obtained by Panja *et al.* in 2001 who showed that PTS 12, PTS 62 and ACC 360 ACC 361, Roma, BSR 1 and Kasturi were resistant to leaf blotch of turmeric.

MATERIALS AND METHODS

Field experiment was conducted in the year 2013-14, 2014-15 and 2015-16 in the experimental field of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar in Randomized block Design with 10 genotypes (as above) alone with one check (TCP2) and with 3 replications.

Planting of rhizome was done at 3m × 1m plot with 30cm × 20 cm spacing and fertilizer at rate of 60:60:60 kg Nitrogen, Phosphorus, Potash per ha and FYM at the rate of 10 – 15 Kg / plot were applied. Other intercultural operations were practiced as per recommended for commercial cultivation of Turmeric. Disease severity was recorded on 20 randomly selected leaves in each plot on 0-9 point disease rating scale (Singh, *et al.* 2000). PDI was calculated using the following formula:

$$\text{Percentage Disease index (PDI)} = \frac{\text{Sum of all rating}}{\text{Total number of rating} \times \text{Maximum disease scale}} \times 100$$

Fresh rhizome yield was recorded at the time of harvesting.

Place and origins of Genotypes: Place and origin of genotypes is presented in Table 1

Table 1: Place and Origins of Genotypes Selected for Evaluation in Terai Region of West Bengal

Sl. No.	Germplasm	Place of Origin	Latitude	Longitude	Altitude	District	State
1.	CL 32	Coimbatore	11°0'N	76°95' E	432 m	Coimbatore	Tamil Nadu
2	CL 34	Coimbatore	11°0'N	76°95' E	432 m	Coimbatore	Tamil Nadu
3	CL 52	Coimbatore	11°0'N	76°95' E	432 m	Coimbatore	Tamil Nadu
4	CL 54	Coimbatore	11°0'N	76°95' E	432 m	Coimbatore	Tamil Nadu
5	RH 406	Dholi	25.99 N	85.58 E	55 m	Muzaffarpur	Bihar
6	RH 407	Dholi	25.99 N	85.58 E	55 m	Muzaffarpur	Bihar
7	RH 410	Dholi	25.99 N	85.58 E	55 m	Muzaffarpur	Bihar
8	TCP 14	Pundibari	26.52 N	89.10 E	66 m	Coochbehar	West Bengal
9	TCP 129	Pundibari	26.52 N	89.10 E	66 m	Coochbehar	West Bengal
10	TCP 161	Pundibari	26.52 N	89.10 E	66 m	Coochbehar	West Bengal
11.	TCP 2 –Check	Pundibari	26.52 N	89.10 E	66 m	Coochbehar	West Bengal

Statistical Methods: All the germplasms were placed in Randomized Block Design (RBD) (Gomez and Gomez, 1985) and 11 genotypes were measured for their tolerance in the field gene bank of Uttar banga Krishi viswavidyalaya. Three replications were done to observe the best suitable genotype which will be high in tolerance of leaf and leaf blotch disease respectively. The observations were investigated in ($P < 0.5$) level of significance where best suitable genotype were found among the 10 genotypes considering high level of tolerance and high yield compared to check variety TCP-2.

RESULTS AND DISCUSSIONS

From the above 2013-14 results (Table No. 2), it is evident that TCP 129 recorded lowest leaf blotch (PDI 11.11) and leaf spot (PDI 6.58) disease severity among the 11 germplasms tested including the local check. TCP 14 produced the second lowest leaf blotch disease severity (PDI 11.93) and CL 52 produced second lowest leaf spot disease severity (PDI 7.00). The highest leaf blotch disease severity (PDI 41.56) was recorded by RH 406 and RH 407 both whereas the highest leaf spot disease severity (PDI 43.00) was recorded by RH 410. TCP 129 produced 57.15% and 76.47% less leaf blotch and leaf spot disease over local check respectively. Over all 4 germplasms produced lower leaf blotch disease severity and 6 germplasm produced lower leaf spot disease severity than local check (TCP 2).

The highest yield of 13.70 Kg/plot (27.62 t/ha) was obtained by TCP 129 which is followed by TCP 14 with 10.30 Kg/plot (20.76 t/ha). The lowest yield of 4.27 Kg/plot (8.60 t/ha) was recorded by RH 410 (Table-4).

From the above 2014-15 results (Table 2), it is evident that TCP 129 recorded lowest leaf blotch (PDI 11.18) and leaf spot (PDI 6.54) disease severity among the 11 germplasm tested including the local check. TCP 14 produced the second lowest leaf blotch disease severity (PDI 12.03) and CL 52 produced second lowest leaf spot disease severity (PDI 8.57). The highest leaf blotch disease severity (PDI 41.93) was recorded by RH 407 whereas the highest leaf spot disease severity (PDI 43.35) was recorded by RH 410. TCP 129 produced 56.68% and 76.14% less leaf blotch and leaf spot disease over local check respectively

The highest yield of 11.00 Kg/plot (22.11 t/ha) was obtained by TCP 129 which is followed by TCP 14 with 8.37 Kg/plot (16.87 t/ha). The lowest yield of 5.40 Kg/plot (10.89 t/ha) was recorded by RH 407. It is evident that TCP 129 was recorded lowest leaf blotch (PDI 16.05) and leaf spot (PDI 8.64) disease severity among the 11 germplasms tested including the local check. TCP 14 produced the second lowest leaf blotch disease severity (PDI 16.46) leaf spot disease severity (PDI 9.47). The highest leaf blotch disease severity (PDI 29.22) was recorded by RH 406 whereas the highest leaf spot disease severity (PDI 22.64) was recorded by RH 410. TCP 129 produced 25.00% and 50.03% less leaf blotch and leaf spot disease over local check respectively.

The highest yield of 18.37Kg/plot (37.03t/ha) was obtained by TCP 129 which is followed by TCP 14 with 16.10Kg/plot (32.46 t/ha). The lowest yield of 7.67 Kg/plot (15.46 t/ha) was recorded by TCP 2 (Table 4). From the above pooled results (Table 2 and Table 3), it is evident that TCP 129 recorded lowest leaf blotch (PDI 12.78) and leaf spot (PDI 7.26) disease severity among the 11 germplasm tested including the local check. TCP 14 produced the second lowest leaf blotch disease severity (PDI 13.47) and CL 52 produced second lowest leaf spot disease severity (PDI 8.76).

The highest leaf blotch disease severity (PDI 37.39) was recorded by RH 406 closely followed by RH 407 (PDI 37.16) (Table 2) whereas the highest leaf spot disease severity (PDI 36.38) was recorded by RH 410 (Table 3). TCP 129 produced 46.48% and 70.03% less leaf blotch and leaf spot disease over local check respectively (Table 2 and Table 3).

Over all 4 germplasms produced lower leaf blotch disease severity and 7 germplasms produced lower leaf spot disease severity than local check (TCP 2). The highest yield of 14.34Kg/plot (28.91t/ha) was obtained by TCP 129 which is followed by TCP 14 with 11.59 Kg/plot (23.37t/ha) and CL 34 with a yield of 9.30 Kg/plot (18.75 t/ha). The lowest yield of 7.36 Kg/plot (14.84 t/ha) was recorded by TCP 2 (Table 4).

CONCLUSIONS

It is therefore experimentally found that TCP 129 was least infested with leaf blotch (46.48% over local check TCP-2) and (70.03% less leaf spot disease over local check TCP-2) and produced highest yield over other rest of the genotypes of yield 14.34 kg/plot with the projected yield of 238.91t/ha followed by TCP 14 with 11.59 kg/plot with 23.37kg/ha of projected yield. TCP 129 and TCP 14 were therefore highly recommended to grow for the benefit of farmers in this terai region of West Bengal.

Table 2: Germination, Percent Disease Index of Leaf Blotch Disease and % Reduction over Check of different Genotypes of Turmeric

Treatments	Germination (%)				Leaf Blotch (PDI)				% Reduction Over Check			
	2013-14	2014-15	2015-16	Pooled	2013-14	2014-15	2015-16	Pooled	2013-14	2014-15	2015-16	Pooled
CL 32	95.00 (77.08)	95.67 (77.99)	96.67 (79.49)	95.78 (79.91)	26.13 (30.74)	26.37 (30.90)	22.22 (28.12)	24.91 (29.92)	---	---	---	---
CL 34	98.33 (82.58)	98.33 (82.57)	97.33 (80.60)	98.00 (82.97)	22.43 (28.27)	22.18 (28.10)	20.58 (26.98)	21.73 (27.70)	13.51	14.06	2.90	9.00
CL 52	93.33 (75.04)	94.00 (75.82)	97.33 (80.60)	94.94 (77.72)	12.76 (20.93)	12.93 (21.07)	17.28 (24.56)	14.32 (22.14)	50.80	49.90	19.25	40.03
CL 54	94.17 (76.02)	94.00 (75.82)	96.67 (79.49)	94.94 (78.46)	29.22 (32.72)	29.26 (32.75)	20.16 (26.68)	26.21 (30.69)	---	---	5.79	---
RH 406	97.50 (80.90)	97.67 (81.22)	98.00 (81.87)	97.72 (81.91)	41.56 (40.14)	41.38 (40.04)	29.22 (32.72)	37.39 (40.07)	---	---	---	---
RH 407	96.67 (79.48)	96.33 (78.96)	98.67 (83.38)	97.22 (80.05)	41.56 (40.14)	41.93 (40.36)	27.98 (31.94)	37.16 (40.25)	---	---	---	---
RH 410	98.33 (82.58)	98.00 (81.87)	94.67 (76.65)	97.00 (82.49)	39.51 (38.94)	39.88 (39.16)	24.28 (29.52)	31.48 (23.02)	---	---	---	---
TCP 14	98.33 (82.58)	98.33 (82.57)	100.00 (90.00)	98.89 (86.01)	11.93 (20.21)	12.03 (20.29)	16.46 (23.94)	13.47 (21.46)	53.98	53.39	23.08	---
TCP 129	97.50 (80.90)	97.33 (80.60)	99.33 (85.30)	98.06 (83.62)	11.11 (19.47)	11.18 (19.53)	16.05 (23.62)	12.78 (20.87)	57.15	56.68	25.00	46.48
TCP 161	95.83 (78.22)	95.33 (77.52)	97.33 (80.60)	96.17 (80.43)	27.98 (31.94)	27.51 (31.63)	17.20 (24.50)	24.26 (29.37)	---	---	19.63	43.59
TCP 2 (Local check)	96.67 (79.48)	96.33 (78.96)	93.33 (75.03)	95.44 (78.80)	25.93 (30.61)	25.81 (30.53)	21.40 (27.56)	23.88 (29.49)	---	---	---	---
SEm (±)	3.560	2.0434	4.4226	2.3772	1.369	1.2734	1.0830	0.9524	---	---	-	-
CD (at 5%)	10.503	6.028	9.2253	4.7308	4.037	3.7567	2.2590	1.9051	---	---	-	-
CV (%)	7.565	4.424	6.570	6.1863	7.814	7.265	4.862	15.8447	---	---	-	-

(Figures in parenthesis are angular transformed value).

Table 3: Percent Disease Index of Leaf Spot Disease and % Reduction over Check of different Entries of Turmeric

Treatments	Leaf Spot (PDI)				% Reduction Over Check			
	2013-14	2014-15	2015-16	Pooled	2013-14	2014-15	2015-16	Pooled
CL 32	24.28 (29.52)	24.26 (29.51)	13.99 (21.96)	20.84 (26.98)	13.22	11.49	19.08	14.00
CL 34	19.34 (26.09)	19.15 (26.21)	11.93 (20.21)	16.81 (24.00)	30.87	30.14	31.00	30.62
CL 52	7.00 (15.34)	8.57 (17.02)	10.70 (19.09)	8.76 (16.99)	75.00	68.73	38.11	63.85
CL 54	26.95 (31.28)	26.33 (30.87)	14.40 (22.30)	22.56 (28.07)	3.66	3.94	16.71	6.89
RH 406	36.63 (37.24)	35.96 (36.85)	18.52 (25.49)	30.37 (36.95)	---	---	---	---
RH 407	39.92 (39.18)	36.55 (37.20)	18.93 (25.79)	31.80 (37.82)	---	---	---	---
RH 410	43.00 (40.98)	43.35 (41.18)	22.64 (28.41)	36.38 (19.20)	---	---	---	---
TCP 14	8.64 (17.10)	8.68 (17.13)	9.47 (17.92)	8.93 (17.22)	69.11	68.33	45.23	63.14
TCP 129	6.58 (14.87)	6.54 (14.82)	8.64 (17.09)	7.26 (15.47)	76.47	76.14	50.03	70.03
TCP 161	33.33 (35.26)	33.11 (35.13)	15.23 (22.97)	27.22 (31.08)	---	---	11.91	---
TCP 2 (Local check)	27.98 (31.94)	27.41 (31.57)	17.29 (24.57)	24.23 (29.31)	---	---	---	---
SEm (±)	1.876	1.5466	1.7659	1.2887	---	---	---	---
CD (at 5%)	5.535	4.5624	3.6837	2.5779	---	---	---	---
CV(%)	11.253	9.307	9.702	10.0886	---	---	---	---

(Figures in parenthesis are angular transformed value)

Table 4: Yield and Projected Yield of Different Genotypes of Turmeric

Treatments	Yield (kg/plot 3 m × 1 m)				Projected Yield (ton/ha)			
	2013-14	2014-15	2015-16	Pooled	2013-14	2014-15	2015-16	Pooled
CL 32	6.47	6.1	15.13	9.23	13.04	12.30	30.50	18.61
CL 34	7.00	6.4	14.47	9.30	14.11	12.97	29.17	18.75
CL 52	9.50	7.2	13.90	8.21	19.15	15.25	28.02	16.55
CL 54	5.40	5.5	14.83	8.54	10.89	11.89	29.90	17.22
RH 406	4.60	6.0	14.27	8.29	9.27	12.10	28.77	16.71
RH 407	4.97	5.4	13.90	8.10	10.01	10.89	28.02	16.33
RH 410	4.27	6.2	13.03	7.83	8.60	12.50	26.27	15.79
TCP 14	10.30	8.37	16.10	11.59	20.76	16.87	32.46	23.37
TCP 129	13.70	11.0	18.37	14.34	27.62	22.11	37.03	28.91
TCP 161	6.40	6.1	14.67	9.07	12.90	12.36	29.57	18.29
TCP 2 (Local check)	7.50	7.25	7.67	7.36	15.12	14.16	15.46	14.84
SEm (±)	0.735	0.4961	1.5907	0.6751	-	-		
CD (at 5%)	2.167	1.4635	3.3181	1.3503	-	-		
CV	17.471	12.516	13.708	14.565	-	-		

(Figures in parenthesis are angular transformed value)

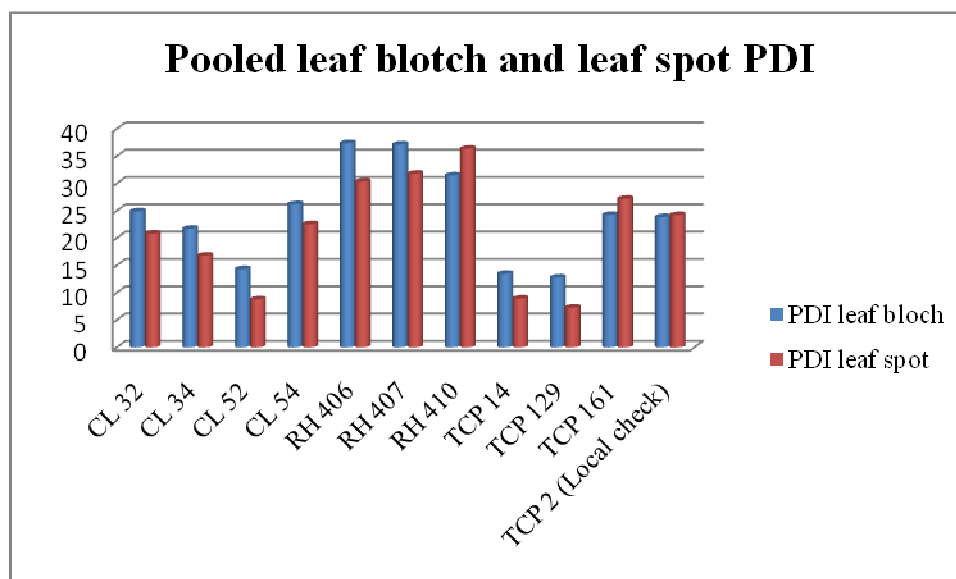


Figure 1: PDI for Leaf Blotch & Leaf Spot of Turmeric for Different Genotypes

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